BTEC Assignment Brief

Qualification	Pearson BTEC International Level 3 Subsidiary Diploma in Applied Science Pearson BTEC International Level 3 Foundation Diploma in Applied Science Pearson BTEC International Level 3 Diploma in Applied Science Pearson BTEC International Level 3 Diploma in Environmental Science Pearson BTEC International Level 3 Extended Diploma in Applied Science Pearson BTEC International Level 3 Extended Diploma in Environmental Science
Unit number and title	**Unit 17: Electrical Circuits and their Applications**
Learning aim	**A**: Understand electrical symbols, units, definitions, relationships and properties of circuit components for use in the construction of circuits. **B**: Construct series and parallel circuits for use in standard electrical applications and measure electrical values.
Assignment title	**Circuits**
Assessor	
Issue date	
Hand in deadline	

Vocational Scenario or Context	You are a trainee technician working for a company that specialises in producing specialist medical equipment such as electrocardiography, electromyography and electroencephalography machines. As part of your induction, you have been asked to produce a report that demonstrates your knowledge of electrical concepts and shows that you are able to assemble various electrical circuits.

Task	Using your notes and research, produce an '**Electrical Circuits Information Report**' containing the following sections: <u>Section 1 – Electrical symbols, units and definitions</u> State the symbols for the following cell components in a table: • cell • battery • switch • filament lamp • fixed resistor • thermistor • light emitting diode (LED) • light-dependent resistor (LDR) • rheostat

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- capacitor
- voltmeter
- ammeter.

Produce a 'Glossary of Terms' that defines and gives a brief explanation of each of the following:

- current (ampere)
- potential difference (volt)
- electrical charge (coulomb)
- resistance (ohm)
- conductance (siemen)
- electrical power (watt)
- capacitance (farad and sub-units)
- current in terms of rate of flow of mobile charge carriers
- electromotive force (EMF) as a measure of ratio of energy supplied per unit of charge
- conductance and resistance in relation to density of mobile charge carriers.

Ensure the glossary includes the symbols for units where applicable.

<u>Section 2 - Electrical formulae and relationships</u>

Draw diagrams of theoretical circuits and use the following electrical formulae to accurately calculate a range of electrical quantities. As part of your working, explain the following equations and how you have applied them:

- Energy supplied: W = VIt
- Kirchoff's first and second rules
- Ohm's Law: V = IR
- Power: P = IV, P = I^2R
- Charge: Q = It
- Conductance: $G=\frac{I}{R}=\frac{I}{V}$
- Resistivity: $R=\frac{pl}{A}(\Omega m)$
- Charge stored by a capacitor Q = CV
- Calculations of capacitance:
  - In parallel circuits $C_T = C_1 + C_2$
  - In series circuits $\frac{1}{C_T}=\frac{1}{C_1}=\frac{1}{C_2}$

<u>Section 3 - Electrical properties and uses of materials</u>

Choose suitable examples of materials and their uses in order to provide an illustrated **explanation** of the properties of the following: conductivity, resistivity, insulators and conductors, ohmic and non-ohmic conductors, capacitors acting as filters in AC circuits and semi-conductors.

You will now test a variety of circuit components to show that the medical equipment will work properly.

Section 4 - Experiment 1: Ohmic and non-ohmic behaviour

Accurately construct a circuit with the following resistors (in turn) connected in series with a switch and power source: Constantan wire, a commercial resistor and a filament light bulb. Connect an ammeter and voltmeter and **record** the voltage and current over a range of values for voltage. Use a table to present your readings.

Plot graphs of voltage against current and interpret the graph to **evaluate** which resistors obey Ohm's Law and which do not. Apply Ohm's Law to predict the current for the commercial resistor at known voltages and **compare** the predicted values to your measured values. Make comments about the accuracy of your practical readings and any suggested improvements you would make to your practical. To explain any discrepancies between your actual and the research values.

Section 5 - Experiment 2: Resistance in series and parallel circuits
Use three resistors (100Ω, 200Ω and 300Ω) in series, parallel and combined circuits, by **comparing** measured values of voltage and resistance to your predicted values of voltage and resistance.

Accurately construct the circuits and take measurements, after your assessor has checked and confirmed your circuits are safe.

- Measure the resistance of the individual resistors using an ohm setting on the multi-meter. Use these measurements to predict the theoretical value of the total resistance of the circuit.
- For voltage outputs from the power pack of 1.0V- 6.0V in 1.0V steps, measure the current and record the results in a table.
- Calculate the total resistance of the circuit at each voltage and **compare** it to predicted value of total resistance.
- At a voltage output of 6.0V, measure potential difference across each resistor. Record any observations about the values you obtain.

Use your calculations and comparisons to **evaluate** the operation of your circuits. Include graphical representations for appropriate electrical relationships (e.g. resistance, power, charge) to support your evaluation.

Section 6 - Experiment 3: Capacitors in series and parallel circuits

Accurately construct simple circuits containing three capacitors and a power pack, firstly with the capacitors in series and then in

	parallel. Take measurements of capacitance, after your assessor has checked and confirmed your circuits are safe. • Make a valid comment as to whether your measurements support the theory that the total capacitance in a parallel circuit is the total of the individual capacitance of each capacitor added together. • Make a valid comment as to whether your measurements support the theory that the total capacitance in a series circuit is less than the capacitance of any individual capacitor in the circuit. <u>Section 7 - Experiment 4: Potential divider circuit</u> Voltage dividers are widely used in electric meter circuits, where specific combinations of series resistors are used to "divide" a voltage into precise proportions as part of a voltage measurement device. Research how to build voltage divider circuits and demonstrate through experiment how to divide a 6.0V power output into 1V, 2V and 3V using three resistors. Show your calculations (Kirchoff's laws) to predict what voltage you will get from your resistors, and then measure the actual voltage. **Compare** your predicted and measured values. Use your calculations and comparisons to **evaluate** the operation of your divider circuit. Your evaluation should consider the following: • Graphical representations for electrical relationships (e.g. resistance, power, charge) • Reliability of your results over a given range • Limitations of the investigation, and ways to improve future experimental work
Checklist of evidence required	An 'Electrical Circuits information Report' that: • explains the principle electrical terms, quantities and relationships • evaluates the difference between ohmic and non-ohmic behaviour of resistors through practical investigation • compares and evaluates predicted and measured voltage and resistance in series, parallel and combined circuits • compares the total capacitance in a series circuit to that in a parallel circuit • investigates and evaluates the practical construction of simple voltage divider circuits.

Criteria covered by this task:	
Unit/Criteria reference	To achieve the criteria, you must show that you are able to:
AB.D1	Evaluate, by calculation and graphical representation, the operation of a range of circuit assemblies using measured values
A.M1	Demonstrate, by calculation, the use of principle electrical terms, quantities and relationships for given situations
B.M2	Compare predicted and calculated fundamental electrical values for a range of circuit assemblies
A.P1	Explain principle electrical terms, quantities and relationships for given situations

B.P2	Accurately construct a range of circuits and record appropriate values accurately using suitable measurement devices

Sources of information to support you with this Assignment	http://www.lectures4you.de/pdf/chris_prot/Ohmlaw.pdf http://www.phy.olemiss.edu/~thomas/weblab/215_lab_items/20_215_proce_Series_Spr2006.pdf http://www.allaboutcircuits.com/textbook/direct-current/chpt-6/voltage-divider-circuits/ https://science.iit.edu/sites/science/files/elements/phy/pdfs/Lab-4-Capacitors-F14.pdf http://hyperphysics.phy-astr.gsu.edu/hbase/electric/capac.html#c2 Centres are encouraged to include local employers in delivery by asking them to give guest lectures and provide opportunities for industrial visits and work experience.